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New World Order

Labor, Capital, and Ideas in the Power Law Economy

Erik Brynjolfsson, Andrew McAfee, and Michael Spence

Recent advances in technology have created an increasingly unified global marketplace for labor and capital. The ability of both to flow to their highest-value uses, regardless of their location, is equalizing their prices across the globe. In recent years, this broad factor-price equalization has benefited nations with abundant low-cost labor and those with access to cheap capital. Some have argued that the current era of rapid technological progress serves labor, and some have argued that it serves capital. What both camps have slighted is the fact that technology is not only integrating existing sources of labor and capital but also creating new ones.

Machines are substituting for more types of human labor than ever before. As they replicate themselves, they are also creating more capital. This means that the real winners of the future will not be the providers of cheap labor or the owners of ordinary capital, both of whom will be increasingly squeezed by automation. Fortune will instead favor a third group: those who can innovate and create new products, services, and business models.

The distribution of income for this creative class typically takes the form of a power law, with a small number of winners capturing most of the rewards and a long tail consisting of the rest of the

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participants. So in the future, ideas will be the real scarce inputs in the world—scarcer than both labor and capital—and the few who provide good ideas will reap huge rewards. Assuring an acceptable standard of living for the rest and building inclusive economies and societies will become increasingly important challenges in the years to come.

LABOR PAINS

Turn over your iPhone and you can read an eight-word business plan that has served Apple well: “Designed by Apple in California. Assembled in China.” With a market capitalization of over \$500 billion, Apple has become the most valuable company in the world. Variants of this strategy have worked not only for Apple and other large global enterprises but also for medium-sized firms and even “micro-multinationals.” More and more companies have been riding the two great forces of our era—technology and globalization—to profits.

Technology has sped globalization forward, dramatically lowering communication and transaction costs and moving the world much closer to a single, large global market for labor, capital, and other inputs to production. Even though labor is not fully mobile, the other factors increasingly are. As a result, the various components of global supply chains can move to labor’s location with little friction or cost. About one-third of the goods and services in advanced economies are tradable, and the figure is rising. And the effect of global competition spills over to the nontradable part of the economy, in both advanced and developing economies.

All of this creates opportunities for not only greater efficiencies and profits but also enormous dislocations. If a worker in China or India can do the same work as one in the United States, then the laws of economics dictate that they will end up earning similar wages (adjusted for some other differences in national productivity). That’s good news for overall economic efficiency, for consumers, and for workers in developing countries—but not for workers in developed countries who now face low-cost competition. Research indicates that the tradable sectors of advanced industrial countries have not been net employment generators for two decades. That means job creation now takes place almost exclusively within the large nontradable sector, whose wages are held down by increasing competition from workers displaced from the tradable sector.

Even as the globalization story continues, however, an even bigger one is starting to unfold: the story of automation, including artificial intelligence, robotics, 3-D printing, and so on. And this second story is surpassing the first, with some of its greatest effects destined to hit relatively unskilled workers in developing nations.

Visit a factory in China's Guangdong Province, for example, and you will see thousands of young people working day in and day out on routine, repetitive tasks, such as connecting two parts

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of a keyboard. Such jobs are rarely, if ever, seen anymore in the United States or the rest of the rich world. But they may not exist for long in China and the rest of the developing world either, for they involve exactly the type of tasks that are easy for robots to do. As intelligent machines become

cheaper and more capable, they will increasingly replace human labor, especially in relatively structured environments such as factories and especially for the most routine and repetitive tasks. To put it another way, offshoring is often only a way station on the road to automation.

This will happen even where labor costs are low. Indeed, Foxconn, the Chinese company that assembles iPhones and iPads, employs more than a million low-income workers—but now, it is supplementing and replacing them with a growing army of robots. So after many manufacturing jobs moved from the United States to China, they appear to be vanishing from China as well. (Reliable data on this transition are hard to come by. Official Chinese figures report a decline of 30 million manufacturing jobs since 1996, or 25 percent of the total, even as manufacturing output has soared by over 70 percent, but part of that drop may reflect revisions in the methods of gathering data.) As work stops chasing cheap labor, moreover, it will gravitate toward wherever the final market is, since that will add value by shortening delivery times, reducing inventory costs, and the like.

The growing capabilities of automation threaten one of the most reliable strategies that poor countries have used to attract outside investment: offering low wages to compensate for low productivity and skill levels. And the trend will extend beyond manufacturing.

Interactive voice response systems, for example, are reducing the requirement for direct person-to-person interaction, spelling trouble for call centers in the developing world. Similarly, increasingly reliable computer programs will cut into transcription work now often done in the developing world. In more and more domains, the most cost-effective source of “labor” is becoming intelligent and flexible machines as opposed to low-wage humans in other countries.

CAPITAL PUNISHMENT

If cheap, abundant labor is no longer a clear path to economic progress, then what is? One school of thought points to the growing contributions of capital: the physical and intangible assets that combine with labor to produce the goods and services in an economy (think of equipment, buildings, patents, brands, and so on). As the economist Thomas Piketty argues in his best-selling book *Capital in the Twenty-first Century*, capital’s share of the economy tends to grow when the rate of return on it is greater than the general rate of economic growth, a condition he predicts for the future. The “capital deepening” of economies that Piketty forecasts will be accelerated further as robots, computers, and software (all of which are forms of capital) increasingly substitute for human workers. Evidence indicates that just such a form of capital-based technological change is taking place in the United States and around the world.

In the past decade, the historically consistent division in the United States between the share of total national income going to labor and that going to physical capital seems to have changed significantly. As the economists Susan Fleck, John Glaser, and Shawn Sprague noted in the U.S. Bureau of Labor Statistics’ *Monthly Labor Review* in 2011, “Labor share averaged 64.3 percent from 1947 to 2000. Labor share has declined over the past decade, falling to its lowest point in the third quarter of 2010, 57.8 percent.” Recent moves to “re-shore” production from overseas, including Apple’s decision to produce its new Mac Pro computer in Texas, will do little to reverse this trend. For in order to be economically viable, these new domestic manufacturing facilities will need to be highly automated.

Other countries are witnessing similar trends. The economists Loukas Karabarbounis and Brent Neiman have documented significant declines in labor’s share of GDP in 42 of the 59 countries they studied,

including China, India, and Mexico. In describing their findings, Karabarounis and Neiman are explicit that progress in digital technologies is an important driver of this phenomenon: "The decrease in the relative price of investment goods, often attributed to advances in information technology and the computer age, induced firms to shift away from labor and toward capital. The lower price of investment goods explains roughly half of the observed decline in the labor share."

But if capital's share of national income has been growing, the continuation of such a trend into the future may be in jeopardy as a new challenge to capital emerges—not from a revived labor sector but from an increasingly important unit within its own ranks: digital capital.

In a free market, the biggest premiums go to the scarcest inputs needed for production. In a world where capital such as software and robots can be replicated cheaply, its marginal value will tend to fall, even if more of it is used in the aggregate. And as more capital is added cheaply at the margin, the value of existing capital will actually be driven down. Unlike, say, traditional factories, many types of digital capital can be added extremely cheaply. Software can be duplicated and distributed at almost zero incremental cost. And many elements of computer hardware, governed by variants of Moore's law, get quickly and consistently cheaper over time. Digital capital, in short, is abundant, has low marginal costs, and is increasingly important in almost every industry.

Even as production becomes more capital-intensive, therefore, the rewards earned by capitalists as a group may not necessarily continue to grow relative to labor. The shares will depend on the exact details of the production, distribution, and governance systems.

Most of all, the payoff will depend on which inputs to production are scarcest. If digital technologies create cheap substitutes for a growing set of jobs, then it is not a good time to be a laborer. But if digital technologies also increasingly substitute for capital, then all owners of capital should not expect to earn outsized returns, either.

TECHCRUNCH DISRUPT

What will be the scarcest, and hence the most valuable, resource in what two of us (Erik Brynjolfsson and Andrew McAfee) have called "the second machine age," an era driven by digital technologies

and their associated economic characteristics? It will be neither ordinary labor nor ordinary capital but people who can create new ideas and innovations.

Such people have always been economically valuable, of course, and have often profited handsomely from their innovations as a result. But they had to share the returns on their ideas with the labor and capital that were necessary for bringing them into the marketplace. Digital technologies increasingly make both ordinary labor and ordinary capital commodities, and so a greater share of the rewards from ideas will go to the creators, innovators, and entrepreneurs. People with ideas, not workers or investors, will be the scarcest resource.

The most basic model economists use to explain technology's impact treats it as a simple multiplier for everything else, increasing overall productivity evenly for everyone. This model is used in most introductory economics classes and provides the foundation for the common—and, until recently, very sensible—intuition that a rising tide of technological progress will lift all boats equally, making all workers more productive and hence more valuable.

A slightly more complex and realistic model, however, allows for the possibility that technology may not affect all inputs equally but instead favor some more than others. Skill-based technical change, for example, plays to the advantage of more skilled workers relative to less skilled ones, and capital-based technical change favors capital relative to labor. Both of those types of technical change have been important in the past, but increasingly, a third type—what we call superstar-based technical change—is upending the global economy.

Today, it is possible to take many important goods, services, and processes and codify them. Once codified, they can be digitized, and once digitized, they can be replicated. Digital copies can be made at virtually zero cost and transmitted anywhere in the world almost instantaneously, each an exact replica of the original. The combination of these three characteristics—extremely low cost, rapid ubiquity, and perfect fidelity—leads to some weird and wonderful economics. It can create abundance where there had been scarcity, not only for consumer goods, such as music videos, but also for economic inputs, such as certain types of labor and capital.

The returns in such markets typically follow a distinct pattern—a power law, or Pareto curve, in which a small number of players

reap a disproportionate share of the rewards. Network effects, whereby a product becomes more valuable the more users it has, can also generate these kinds of winner-take-all or winner-take-

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most markets. Consider Instagram, the photo-sharing platform, as an example of the economics of the digital, networked economy. The 14 people who created the company didn't need a lot of unskilled human helpers to do so, nor did they need much physical capital. They built a digital product that benefited from network effects, and when it caught on quickly, they

were able to sell it after only a year and a half for nearly three-quarters of a billion dollars—ironically, months after the bankruptcy of another photography company, Kodak, that at its peak had employed some 145,000 people and held billions of dollars in capital assets.

Instagram is an extreme example of a more general rule. More often than not, when improvements in digital technologies make it more attractive to digitize a product or process, superstars see a boost in their incomes, whereas second bests, second movers, and latecomers have a harder time competing. The top performers in music, sports, and other areas have also seen their reach and incomes grow since the 1980s, directly or indirectly riding the same trends upward.

But it is not only software and media that are being transformed. Digitization and networks are becoming more pervasive in every industry and function across the economy, from retail and financial services to manufacturing and marketing. That means superstar economics are affecting more goods, services, and people than ever before.

Even top executives have started earning rock-star compensation. In 1990, CEO pay in the United States was, on average, 70 times as large as the salaries of other workers; in 2005, it was 300 times as large. Executive compensation more generally has been going in the same direction globally, albeit with considerable variation from country to country. Many forces are at work here, including tax and policy changes, evolving cultural and organizational norms, and plain luck. But as research by one of us (Brynjolfsson) and Heekyung Kim has

shown, a portion of the growth is linked to the greater use of information technology. Technology expands the potential reach, scale, and monitoring capacity of a decision-maker, increasing the value of a good decision-maker by magnifying the potential consequences of his or her choices. Direct management via digital technologies makes a good manager more valuable than in earlier times, when executives had to share control with long chains of subordinates and could affect only a smaller range of activities. Today, the larger the market value of a company, the more compelling the argument for trying to get the very best executives to lead it.

When income is distributed according to a power law, most people will be below the average, and as national economies writ large are increasingly subject to such dynamics, that pattern will play itself out on the national level. And sure enough, the United States today features one of the world's highest levels of real GDP per capita—even as its median income has essentially stagnated for two decades.

PREPARING FOR THE PERMANENT REVOLUTION

The forces at work in the second machine age are powerful, interactive, and complex. It is impossible to look far into the future and predict with any precision what their ultimate impact will be. If individuals, businesses, and governments understand what is going on, however, they can at least try to adjust and adapt.

The United States, for example, stands to win back some business as the second sentence of Apple's eight-word business plan is overturned because its technology and manufacturing operations are once again performed inside U.S. borders. But the first sentence of the plan will become more important than ever, and here, concern, rather than complacency, is in order. For unfortunately, the dynamism and creativity that have made the United States the most innovative nation in the world may be faltering.

Thanks to the ever-onrushing digital revolution, design and innovation have now become part of the tradable sector of the global economy and will face the same sort of competition that has already transformed manufacturing. Leadership in design depends on an educated work force and an entrepreneurial culture, and the traditional American advantage in these areas is declining. Although the United States once led the world in the share of graduates in the work force with at least an associate's degree, it has now fallen to

12th place. And despite the buzz about entrepreneurship in places such as Silicon Valley, data show that since 1996, the number of U.S. start-ups employing more than one person has declined by over 20 percent.

If the trends under discussion are global, their local effects will be shaped, in part, by the social policies and investments that countries choose to make, both in the education sector specifically and in fostering innovation and economic dynamism more generally. For over a century, the U.S. educational system was the envy of the world, with universal K-12 schooling and world-class universities propelling sustained economic growth. But in recent decades, U.S. primary and secondary schooling have become increasingly uneven, with their quality based on neighborhood income levels and often a continued emphasis on rote learning.

Fortunately, the same digital revolution that is transforming product and labor markets can help transform education as well. Online learning can provide students with access to the best teachers, content, and methods regardless of their location, and new data-driven approaches to the field can make it easier to measure students' strengths, weaknesses, and progress. This should create opportunities for personalized learning programs and continuous improvement, using some of the feedback techniques that have already transformed scientific discovery, retail, and manufacturing.

Globalization and technological change may increase the wealth and economic efficiency of nations and the world at large, but they will not work to everybody's advantage, at least in the short to medium term. Ordinary workers, in particular, will continue to bear the brunt of the changes, benefiting as consumers but not necessarily as producers. This means that without further intervention, economic inequality is likely to continue to increase, posing a variety of problems. Unequal incomes can lead to unequal opportunities, depriving nations of access to talent and undermining the social contract. Political power, meanwhile, often follows economic power, in this case undermining democracy.

These challenges can and need to be addressed through the public provision of high-quality basic services, including education, health care, and retirement security. Such services will be crucial for creating genuine equality of opportunity in a rapidly changing economic

environment and increasing intergenerational mobility in income, wealth, and future prospects.

As for spurring economic growth in general, there is a near consensus among serious economists about many of the policies that are necessary. The basic strategy is intellectually simple, if politically difficult: boost public-sector investment over the short and medium term while making such investment more efficient and putting in place a fiscal consolidation plan over the longer term. Public investments are known to yield high returns in basic research in health, science, and technology; in education; and in infrastructure spending on roads, airports, public water and sanitation systems, and energy and communications grids. Increased government spending in these areas would boost economic growth now even as it created real wealth for subsequent generations later.

Should the digital revolution continue to be as powerful in the future as it has been in recent years, the structure of the modern economy and the role of work itself may need to be rethought. As a group, our descendants may work fewer hours and live better—but both the work and the rewards could be spread even more unequally, with a variety of unpleasant consequences. Creating sustainable, equitable, and inclusive growth will require more than business as usual. The place to start is with a proper understanding of just how fast and far things are evolving. 🌐